# IMPROVING THE PERFORMANCE OF AIR-CONDITIONING SYSTEMS IN AN ASEAN CLIMATE*

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## ABSTRACT

This paper describes an analysis of air conditioning performance under hot and humid tropical climate conditions appropriate to the Association of South East Asian Nations (ASEAN) countries. This region, with over 280 million people, has one of the fastest economic and energy consumption growth rates in the world. The work reported here is aimed at estimating the conservation potential derived from good design and control of air conditioning systems in commercial buildings.

To test the performance of different air conditioning system types and control options, whole building energy performance was simulated using DOE-2. The 5,100 $m^2$ (50,000 $ft^2$) prototype office building module was previous used in earlier commercial building energy standards analysis for Malaysia and Singapore. In general, the weather pattern for ASEAN countries is uniform, with hot and humid air masses known as "monsoons" dictating the weather patterns. Since a concentration of cities occurs near the tip of the Malay peninsula, hourly temperature, humidity, and wind speed data for Kuala Lumpur was used for the analysis. Because of the absence of heating loads in ASEAN regions, we have limited air conditioning configurations to two pipe fan coil, constant volume, variable air volume, powered induction, and ceiling bypass configurations. Control strategies were varied to determine the conservation potential in both energy use and peak electric power demands. Sensitivities including fan control, pre-cooling and night ventilation, supply air temperature control, zone temperature set point, ventilation and infiltration, daylighting and internal gains, and system sizing were examined and compared with a base case which was a variable air volume system with no reheat or economizer. Comfort issues, such as overcooling and space humidity, were also examined.

VAV systems clearly have the best performance minimizing energy use while maintaining comfort conditions. Excess outdoor air in this humid climate has a significant energy penalty. Two pipe fan coil units have the lowest energy consumption due to fan energy savings and low latent cooling capacity but perform poorly during morning pull-down periods. Large fan energy savings for all systems can be obtained by using supply air temperatures as low as 7 °C (45 °F). A combination of system conservation measures incorporated into one building saved 14% of annual energy and 16% on peak power. Other results of the analysis will be discussed.

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